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Veröffentlichungsversion / Published Version
Zeitschriftenartikel / journal article

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Empfohlene Zitierung / Suggested Citation:

Liczbińska, G. (2017). Between Religion and Environment: Mortality and Its Causative Factors in Greater Poland in the 19th Century. *Historical Social Research*, 42(2), 114-133. <https://doi.org/10.12759/hsr.42.2017.2.114-133>

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Between Religion and Environment. Mortality and Its Causative Factors in Greater Poland in the 19th Century

Grażyna Liczbińska*

Abstract: »Zwischen Religion und Umwelt. Mortalität und ihre ursächlichen Faktoren in Großpolen im 19. Jahrhundert«. The purpose of the study was to show the differences in mortality in Catholic and Lutheran communities of the 19th-century Greater Poland (Wielkopolska) and its causative factors. Data on mortality were derived from two sources: 1) parish death registers, 2) vital statistics from von Bergmann's monograph. The values of CDRs for Lutherans and Catholics were 29.25 and 31.74, respectively. Infant mortality was also lower in Lutheran populations than in Catholic ones: 258 to 296 infant deaths per 1,000 live births. Higher mortality of Catholic children than Lutheran ones was confirmed by higher values of the Crow's index in the former than in the latter. Life expectancy of a newly born child in Lutherans was 35 years, while in Catholics 4 years lower. Differences in mortality between Catholics and Lutherans in Greater Poland in the 19th century were caused by various factors one of which was religious denomination.

Keywords: Catholics, Lutherans, infant mortality, life expectancy, death rates.

1. Greater Poland in the 19th and Early 20th Centuries

One of historical and geographical parts of Prussia at that time was the Grand Duchy of Poznań (*Grossherzogtum Posen*). It was created following the decision of the Congress of Vienna in 1815. Territorially the Grand Duchy of Poznań overlapped in its vast majority with Greater Poland (*Polish: Wielkopolska*), covering the area of about 29,000 km² and being inhabited by 776,000 people (Kozłowski 1976). It consisted of two districts: the district of Poznań (*Regierungsbezirk Posen*) with a territory of 17,500 km², representing 60% of the entire Grand Duchy of Poznań and comprised of 17 counties. In the 1880s the number of counties increased to 28. The second one was the district of Bydgoszcz, located in the north of the region, with a territory of over 11,000 km², comprising of 9 counties, and in the 1880s – of 14. In 1848 the Grand Duchy of Poznań was re-named and became the Poznań province and as such the admin-

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istrative unit lasted until 1918. The head of the Province was Chief President and Governors of districts and landrats in the counties were subjected to him (Kozłowski 1976, 2009; Liczbińska 2016).

Greater Poland was inhabited by three nations: Poles, Germans and Jews. Germans were immigrants here (Chwalba 2000, Kozłowski 1976). In the 1840s the number of all Germans amounted to 420,000, which constituted 35% of the province population, while the number of Poles was 790,000, which accounted for 65% of the Poznań province population (Matwiejczyk 2009). Of course, the territorial distribution of the German population was unequal: in the counties located in the west and north part of Greater Poland the proportion of Germans was much higher than in the eastern part of the region (Matwiejczyk 2009).

In terms of religious denomination Germans were mostly Lutherans, while Poles – in the vast majority were Catholics. In the district of Poznań Catholics were predominant and their numbers in the whole population of the district was at the level of 70%. In the district of Bydgoszcz in 1880 Catholics amounted to almost 56% of the population, and 25 years later – to over 57%. In the district of Poznań the proportion of Lutherans was over 20%. In turn in the district of Bydgoszcz, since the 1860s until the beginning of the 20th century the Lutheran population was at the level of slightly over 40% of all inhabitants in the district (Liczbińska 2015; Matwiejczyk 2009). At the end of the 19th and the beginning of the 20th centuries a decline in the number of Lutherans in the Poznań province was observed, caused by their increased outflow to the rapidly developing western provinces of Prussia (Kiec 2011a, b; Liczbińska 2015, 2016; Matwiejczyk 2009). According to Borowski's estimates (1968), in Greater Poland in the years 1871-1905 the negative balance of migratory movement increased by 25 times as compared with the earlier period. In the 1870s a great migration from Greater Poland to the Kingdom of Poland, mostly of poor inhabitants from rural areas, was recorded (Jakóbczyk 1959). Next, Brandenburg and Berlin, industrial Saxony and rapidly industrializing Rhine and Westphalia began to attract refugees from Greater Poland, including those of German nationality (see also: Borowski 1962, 1963, 1967; Jakóbczyk 1959).

Both ethnic and religious groups differed in terms of economic status. Economic advancement of Germans could be seen first of all in non-agricultural populations, living mainly in cities of the province. Coming to the Poznań province after 1815 German bourgeoisie sought here an opportunity to get rich quickly and develop their careers. A strong group was represented by people associated with the administrative apparatus of the Prussian state, mainly officials, lawyers and military service. Thanks to the development of administration in the province, Polish officials were supplanted by German ones practically to the second half of the 19th century. German immigrants from Germany to Greater Poland brought their families, friends, and relatives. There were not only officials among them but also merchants, craftsmen and labourers, the last group were hired to build fortifications in the city of Poznań and to construct

highways and railways (Kozłowski 1976, 2009). In the capital of the Poznań province – the city of Poznań, the richest inhabitants were among German merchants. According to the tax lists from 1847, they dominate in the group of tax payers earning above 2,000 and 4,000 tallers (Jaffe 2012, 229). German families made fortunes particularly on timber trade. The richest craft workshops were in the hands of Germans. Socio-economic situation of German rural population in the Poznań province was also much better than that of peasants of Polish nationality (Jakóbczyk 1959; Kozłowski 1976, 2009). Virtually nobody in the German population was landless, also there were no landless tenants (Polish: komornik) and cottage workers (Polish: chałupnik) among them. In villages there were predominantly middle-class and wealthy farmers of German nationality. Such state of affairs was favoured by the policy of Prussian authorities, taking care of Germans and offering them better living conditions, and better and more efficient level of management of German peasants in comparison to rural Polish population (Kozłowski 1976, 2009).

2. Religious Differences in Mortality Rates

With regards to historical populations researchers have stressed the existence of a strong relationship between mortality rates and religious denomination (Haines and Kintner 2000; Kemkes-Grottenthaler 2003; Liczbińska 2009a, b, 2011, 2015; McQuillan 1999; van Poppel 1992; van Poppel et al. 2002; Wolleswinkel-van den Bosch et al. 2000, 2001). Through its norms and values religion shaped a unique way of life and attitude towards health care, sickness, implementation of medical procedures, hygiene and healing (Kemkes-Grottenthaler 2003; Liczbińska 2009a, b, 2011, 2015; McQuillan 1999; van Poppel 1992; van Poppel et al. 2002). There were some differences in the attitude to health, sickness and death between Catholics and Lutherans. Lutheran communities were presented as more receptive to novelties, cared more for hygiene and cleanliness of rooms than Catholics, and coped better with illnesses (Kemkes-Grottenthaler 2003; Liczbińska 2009a, b, 2011, 2015; McQuillan 1999; van Poppel 1992; van Poppel et al. 2002). It has been emphasized in the literature that Protestants were famous in manifestation of efforts undertaken for the sake of health (Kemkes-Grottenthaler 2003; McQuillan 1999; Liczbińska 2009a, b, 2011, 2015; van Poppel 1992). Luther insisted that hospitals should be financially supported by the state, and doctors were expected to treat diseases by all available medical means. Lutherans rejected folk medicine, popular in some Catholic circles. Catholic communities accepted illness, not trying to fight against it, and linking it to a punishment from God. Clerical medicine was popular (*medicina clericalis*), particularly in remote areas, where physicians were not available and priests were the only educated persons (O'Connell 1986; Smylie 1986). Protestant clergymen issued specific rules and

instructions on how to care for health and to treat diseases (Lindberg 1986). Such instructions were published for example in Toruń in 1708 during the plague epidemic. Evangelical pastors preached the so-called “anti-epidemic sermons” in which they stressed the necessity of body care, health care, the use of medicines and the use of hygiene (Pękacka-Falkowska 2011).

Differences in attitudes towards health, sickness and death played a very important role in creating models of behaviour and in shaping a way of life, which in turn translated into mortality rates. The studies of Lutheran and Catholic populations of historical Western Europe have shown that the former seemed to have been coping much better with mortality rates than the latter. McQuillan (1999) studying the German-speaking area of 18th and 19th-century Alsace pointed out the lower infant mortality rates among the population of Lutheran denomination in comparison with the Catholic one and earlier and faster declines in mortality rates among Lutherans than Catholics over time. The lower mortality of children in Lutheran families than Catholic ones has been recorded in the Netherlands and Germany in the second half of the 19th and early 20th centuries (Haines and Kintner 2000; van Poppel and Liefbroer 2005; van Poppel et al. 2005; Wolleswinkel-van den Bosch et al. 1998, 2000, 2001). Generally speaking, the regions of Western Europe, where Lutheran populations predominated, were characterized by lower mortality and its earlier and faster declines over time as compared to areas with a predominance of Catholics (Haines and Kintner 2000; McQuillan 1999; van Poppel 1992; van Poppel et al. 2005; Wolleswinkel-van den Bosch et al. 1998, 2000, 2001).

Researchers have emphasized the fact that women from Lutheran communities breastfed their children longer than Catholic women, which reduced the risk of morbidity of infants and young children due to intestinal diarrhoeas and, consequently, reduced the risk of child's death (e.g. Kemkes-Grottenthaler 2003; Liczbińska 2009a, b, 2011, 2015; McQuillan 1999; van Poppel 1992). Lutheran women had an awareness of the need of professional medical care during childbirth and they gave birth in the presence of a skilled midwife, whereas poorer women – with the help of an experienced local village midwife (*Hebamme, Weise Mutter*) (Liczbińska 2015).

These two religious denominations also revealed different attitudes towards stillbirths. It translated into more reliable recording of births with no signs of life by Protestant communities than by Catholic ones. Catholics believed that a stillborn child, and therefore unbaptized, would not receive salvation (Kemkes-Grottenthaler 2003, van Poppel 1992). Hence, they were ashamed to report stillbirths as they believed that unbaptized children would be buried in non-consecrated parts of cemeteries and their souls would never attain the eternal life (Liczbińska 2009a, b, 2015; van Poppel 1992).

In contrast to Protestant communities in Germany, the Netherlands and France with their distinctive centuries-old tradition and the economic advancement, the one from the Poznań province varied in terms of their origin,

level of education and awareness, traditions, customs, habits, lifestyle, and even wealth (Kiec 2001; Liczbińska 2012, 2015). Thus, lower mortality rates in Lutherans and higher in Catholics, previously discussed in relation to Protestant and Catholic populations of Western Europe, have not been confirmed by pilot studies of the population of both denominations living in the historical Greater Poland (e.g. Liczbińska 2009a, b, 2010, 2011, 2015).

In the light of the above, the aim of this paper is to show and compare mortality rates in Catholics and Lutherans from the 19th-century Greater Poland (Poznań province).

3. Data

Two different sources of information on mortality were used. The first were parish death registers for Catholic and Lutheran parishes from Greater Poland for the years 1850-1899, deposited in the State Archives in Poznań and in the Archdiocese Archives in Poznań. The collected material offers 44,154 excerpts from death registers of Catholics and Lutherans (Table 1). The second source of information on the numbers of deaths of Catholic and Lutheran populations from Greater Poland were provided by vital statistics for 19th-century Poznań province, produced in the monograph by von Bergmann (1883) and published in Germany. This monograph supplied information on 938,833 deaths of Catholics and Lutherans from the Poznań province for the years 1845-1873.

Table 1: Numbers of Deaths of Catholic and Lutheran Populations under Study

Religious denomination	Parish registers	Vital statistics*
Catholics	18,070	516,557
Lutherans	26,084	422,276
Total	44,154	938,833

*After von Bergmann 1883.

4. Methods

Two mortality rates were calculated: Crude Death Rate (CDR) and Infant Mortality Rate (IMR). The former is defined as the ratio of the number of deaths to the total population number in the studied period (Holzer 2003). Infant Mortality Rate (IMR) expressed the ratio of mortality of children below one year of age to the number of live births in the studied period (Holzer 2003). Stillbirths were excluded from analysis of IMR since there were problems with proper recognition of them, especially among the poor. Statistically significant differences in the values of the above rates between religious groups were assessed with the *u* test (Oktaba 1976). The level of significance of $p=0.05$ was adopted.

Life tables were developed for two model situations: a stationary and a stable population basing on material from parish death registers. The stationary population model assumes that the numbers of births and the numbers of deaths are in balance, and sex and age structure are invariable in time. This model is based on the age-at-death distribution of individuals according to Halley's method. A detailed information concerning calculation of the functions of life tables for a stationary population model is described by Acsádi and Neméskei (1970). The stationary population model is referred to mortality in shorter periods of time. With regard to longer periods the assumption of a balance of fertility and mortality is an oversimplification. Stable population model with a non-zero value of natural population growth is more realistic. In this paper the coefficient of natural population growth 'r' for Greater Poland for the years of 1846-1890 was calculated basing on Borowski's data (1970). Next, the rate of population growth was introduced to a stationary population model to re-build the distribution of the deceased by age for a stable population model.

In this study for selected age categories such as: 0, 5, 10, 20, 45, 50 and 60, the following biometric functions of life tables were characterized: proportion of the deceased in a given age category d_x , fraction of the surviving to a given age class l_x , probability of death in a given age category q_x , and life expectancy e_x .

Since the data from the vital statistics of the Catholic and Lutheran population in the Poznań province do not contain any information on the distribution of the deceased by age, the life expectancy of a newly born child e_0 was estimated as the inverse of mortality rates, assuming, after Borowski (1967) that the Greater Poland population in the 19th century was of a stationary character.

On the basis of life table parameters one of the rates of opportunity for natural selection through differential mortality – the Crow's index I_m – was calculated according to the following formula:

$$I_m = P_d/P_s, \text{ where:}$$

P_d – proportion of offspring deceased before reaching reproductive age (14 years) and P_s – proportion of offspring reaching reproductive age ($P_s = 1 - P_d$) (Crow 1958).

Factor analysis allowed checking whether it was possible to select some hidden factors influencing mortality in Greater Poland. The following variables were used in order to conduct it: religious denomination, sex, season of death, degree of urbanization, level of hygiene, age at death, causes of deaths, occupation, and historical period. The "religious denomination" variable allowed separating Catholics and Lutherans. The "sex" variable included females and males. Then the "season of death" variable led to emerging of four categories: winter (December, January, February), spring (March, April, May), summer (June, July, August) and autumn (September, October, November). The "degree of urbanization" variable contained three categories: city, town and village. The "level of hygiene" variable included: poor hygiene (overcrowded

locations, without access to clean water, lack of sanitation) and good hygiene (as the opposite to the previous one). The “age at death” variable consisted of the following age categories: 0-1 year, 2-5 years, 6-14 years, 15-25 years, 26-54 years, 55-x years. “Causes of deaths” included the following four categories: infectious diseases, consumptions, man-made diseases, perinatal deaths, and others. Six categories of the “occupation” variable were developed on the basis of the studied material, namely: intelligentsia (represented by officials, teachers, accountants, lawyers, doctors, and pharmacists), peasants and workers (peasants, day labourers, hired workers and lowest-paid jacks-of-all-trades, skilled workers, and farm labourers), craftsmen (craftsmen and journeymen), owners (of landed estates) and servants (included servants, watchmen, coachmen, etc.). “Historical period” was divided into four categories: 1850-1860, 1861-1870, 1871-1880, and 1881-1899. Factor analysis was performed using the STATISTICA package.

5. Results and Discussion

5.1 Values of Crude Death Rate

In Greater Poland in the second half of the 19th century the values of Crude Death Rates calculated for the population as a whole (without division by religious denomination) ranged between 22-27 deaths per 1,000 people in villages and over 26-31 deaths per 1,000 people in cities and towns (Budnik and Liczbińska 2006). Values of Crude Death Rates calculated in this study based on the data on mortality from Catholic and Lutheran parish death registers amounted to 29 and to over 31 deaths per 1,000 people, respectively (Table 2). Although according to *u* tests the differences in CDRs between the studied populations were statistically significant, they were within the range of the variability of this rate for Greater Poland in the second half of the 19th century (Budnik and Liczbińska 2006).

Table 2: Values of Crude Death Rates (CDRs) in Catholic and Lutheran Populations from Greater Poland in the 19th Century (per 1,000 people)

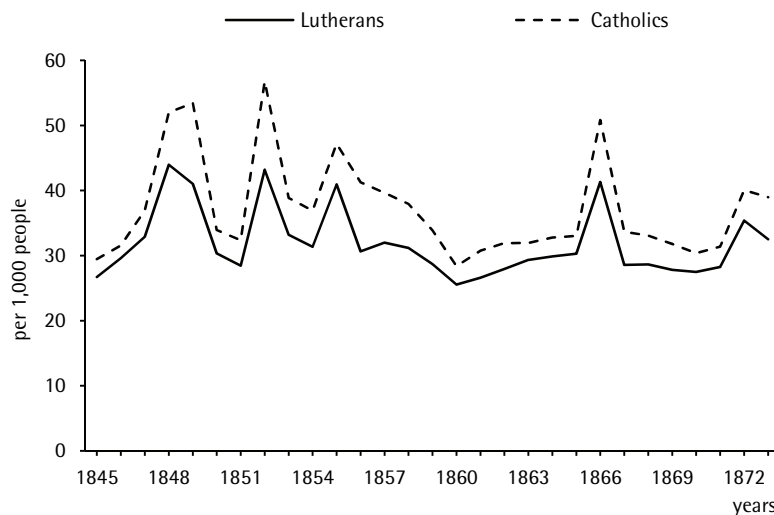
Religious denomination	CDR
Catholics	31.74*
Lutherans	29.25

*Statistically significant differences between Catholics and Lutherans.

Significantly higher mortality in Catholics than in Lutherans was also confirmed by the values of CDRs calculated on the basis of von Bergmann’s vital statistics (Figure 1). Higher CDRs in Catholics than Lutherans from the Poznań

province were also emphasized by Kędelski (1985, 1986). He explained these differences by socio-economic inequalities between the followers of these denominations (Kędelski 1985, 1986). According to him, “both communities (...) widely differed in Greater Poland in terms of social and occupational status, hence differences in their living conditions and quality of life. Among the Catholic population, mostly of Polish nationality, the petty bourgeoisie and the proletariat, but first of all poorer rural population predominated. Lutherans – mostly Germans – were strongly represented by rich bourgeoisie, also intelligentsia increased among them” (1985, 121). In the light of aggregated data published in Prussian Statistical Yearbooks, in Poznań in the years 1876-1885 the value of CDR for Catholics was 34.9, while for Lutherans – 26.1 (Kędelski 1986).

Figure 1: Changes in Crude Death Rates (CDRs) over Time in Catholic and Lutheran Populations from the Poznań Province, 1845-1873



In the years 1855-1874 in the poor Catholic parish of St. Margaret from Poznań, consisting mainly of labourers and unskilled workers – immigrants from Greater Poland villages, the CDR amounted to 33.6 deaths per 1,000 people, while in the richer Lutheran parish of the Holy Cross from the same period – to 27.3. The differences were statistically significant (Liczbńska 2009b). In these studies the higher CDR for Catholics than for Lutherans resulted probably from higher mortality in the poorer population, mainly consisting of labour workers and unskilled workers, living in the outskirts of Greater Poland cities, in very bad economic conditions, which was characteristic for a vast majority by Catholics. In villages the Catholic-Lutheran polarization in the values of CDRs was not as distinguishable as in urban areas. As it has been mentioned earlier,

members of the Lutheran community represented a wealthier and more privileged part of the Poznań population, while Catholics belonged to poorer social classes (Trzeciakowska and Trzeciakowski 1987). In villages and small towns of Greater Poland, by contrast, such social and economic differences between members of these two religious denominations were not so noticeable. Lutherans from rural and urban areas differed in terms of such factors as wealth and education level, living conditions, awareness, and the style and quality of life (Kiec 2001). In the light of the literature, the values of CDRs in the Catholic parishes from Greater Poland villages were at the level of slightly over 20 deaths per 1,000 people, e.g. in the parish of Dziekanowice – 24 deaths per 1,000 people (Budnik et al. 2002) and in the parish of Szczepanowo – 25 deaths per 1,000 people (Henneberg 1977). The same was true in Lutheran ones, e.g. in the parish of Jastrzębsko Stare – 23 deaths per 1,000 people (Liczbińska 2015) and in the parish of Trzebosz – 25 deaths per 1,000 people (author's calculations).

5.2 Infant Mortality Rates

The total mortality was shaped by infant mortality. In Greater Poland in the second half of the 19th century mortality of infants of Catholic denomination was significantly higher than infants of Lutheran religion and amounted to almost 300 deaths per 1,000 live births. The corresponding ratio calculated for Lutheran infants was 258 deaths per 1,000 live births (Table 3). Higher mortality of Catholic infants than Lutheran ones in the Poznań province was also confirmed by the values of IMRs calculated until the 1870s based on von Bergmann's statistics (Figure 2).

Table 3: Values of Infant Mortality Rates (IMRs) in Catholic and Lutheran Populations from Greater Poland in the 19th Century (per 1,000 live births)

Religious denomination	Place of residence	IMR
Catholics	Cities	296.45 ¹
	Villages	345.00 ²
Lutherans	Cities	258.28
	Villages	267.00
		249.00

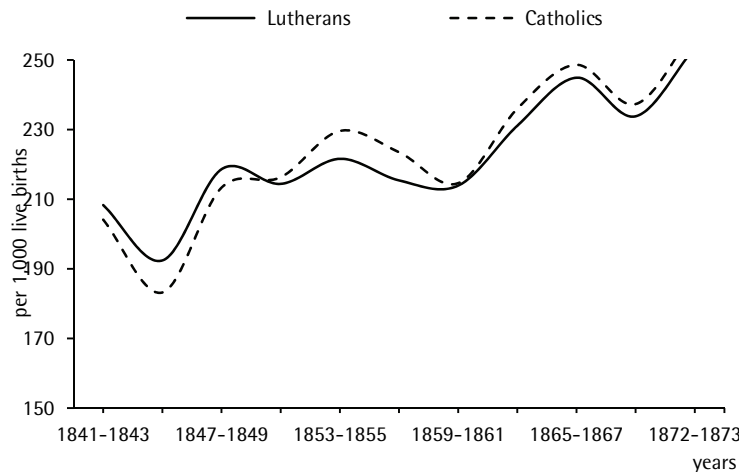
¹ Statistically significant differences between Catholics and Lutherans.

² Statistically significant differences between Catholics and Lutherans from cities.

This study showed not only rural-urban stratification in terms of infant mortality: higher in cities and lower in rural areas (see also: Liczbińska 2010), but also highlighted the fact, which was emphasized earlier in this paper, that the larger town of residence the greater differences in mortality level in favour of Lutherans. For example, the values of IMRs for Lutherans and Catholics from Poznań

amounted to 267 and 345 infant deaths per 1,000 live births, respectively (Table 3). The same figures for Lutherans and Catholics from Greater Poland villages were lower than in Poznań and comparable to each other (248 and 249 deaths per 1,000 live births).

Figure 2: Changes in Infant Mortality Rates (IMRs) over Time in Catholic and Lutheran Populations from the Poznań Province, 1845-1873



Note: The IMRs values for Catholics and Lutherans were calculated based on Kędelski 1985, 124.

In cities high mortality of Catholic infants was probably influenced by high level of child mortality in very poor families of unskilled and daily workers. For example, in the Catholic parish of St. Margaret almost 390 infants per 1,000 live births died before 1 year of age. The parish included the districts of Chwaliszewo and Śródka – some of the poorest, most dilapidated districts of Poznań, seriously lacking in infrastructure, with poor living conditions and very poor hygiene (Karolczak 1997 a, b). Water was drawn here from shallow wells or from the Warta River and primitive street gutters without drainage were still in use. The parish suffered frequently from outbreaks of smallpox, measles, scarlet fever, typhoid, and cholera (Karolczak 1997 a, b, Liczbińska 2009a, b, 2011). The Poznań parish of St. Mary Magdalene located in the city centre was, by contrast, privileged in terms of access to clean water and hygiene level (Kaniecki 2004; Kędelski 1994). It was also characterized by a higher standard of living of its inhabitants and their better economic situation. It is not surprising that a significantly lower infant mortality was recorded there than in the parish of St. Margaret, i.e. at the level of 265 deaths per 1,000 live births (Liczbińska 2009a, b, 2011). Infant mortality in the parish of St. Mary Magdalene was also lower than that in the Lutheran parish of the Holy Cross, where the IMR reached the value of 293 deaths per 1,000 live births

(Liczbińska 2009a, b, 2011). High level of infant mortality in the Lutheran community was caused by varied ecological conditions in the parish. The parish covered a large territory and Lutherans were spread across the whole of Poznań area and sub-Poznań villages and towns. Unfortunately, only the parishioners surrounding Poznań market square benefited from clean water, while the rest of them used contaminated water intakes, located near their homes. This fact translated into the high infant mortality here (Kaniecki 2004; Liczbińska 2009a, b, 2011).

In Greater Poland rural areas, where neither ecological conditions were as varied as in big cities, nor social and economic differences between Catholics and Lutherans were so much perceived, the differences between Catholic and Lutheran populations in terms of infant mortality were not so noticeable. For example, the value of IMR for the Catholic parish of Stare Bojanowo was 226 infant deaths per 1,000 births (author's calculation), while in the Lutheran parishes of Jastrzębsko Stare and Nekiłka – 228 and 230 infant deaths per 1,000 live births, respectively (Liczbińska 2015, author's calculations, respectively).

5.3 Biometric Functions of Life Tables and Crow's Index

The values of the biometric functions of life tables are shown in Table 4 and in Figures 3-4. The life tables' parameters calculated on the basis of age-at-death distribution of individuals were slightly more favourable in Lutherans than in Catholics. In Greater Poland Catholics life expectancy of a newly born child e_0 was over 21 years while in Lutheran population as many as 3 years more than in Catholics in a stationary population model. After the introduction of the rate of population growth, an improvement in life-table parameters was observed (Table 4). In Catholics life expectancy of a newly born child e_0 assumed the value of 31 years (Figure 3). Over 38% of children did not live to 5 years of age and 57% reached reproductive age (conventionally 15 years of age). The q_x parameter (probability of death) confirmed the still high mortality of children until the age of 5 (Table 4). In turn, in Lutherans the value of e_0 was over 35 years, which was as many as 4 years more than in Catholics (Table 4, Figure 3). An average adult Lutheran had a chance to live 38 years (parameter: e_{20}), while an adult Catholic 5 years less. In Lutherans 36% of children did not live to 5 years of age. This was less than in the case of Catholics, but unfortunately confirmed still high infant mortality in 19th-century Greater Poland. Almost 61% of Lutherans did not survive the onset of reproduction. As many as 39-43% of them reached the age of 45-50 years (the productive age), and (conventionally l_{60}) 29% of all Lutherans survived to senility. In the case of Catholics the same parameters were: 30-35% and 20%, respectively.

Figure 3: Life Expectancies e_x in Catholics and Lutheran Populations from Greater Poland in the 19th Century (Stable Population Model)

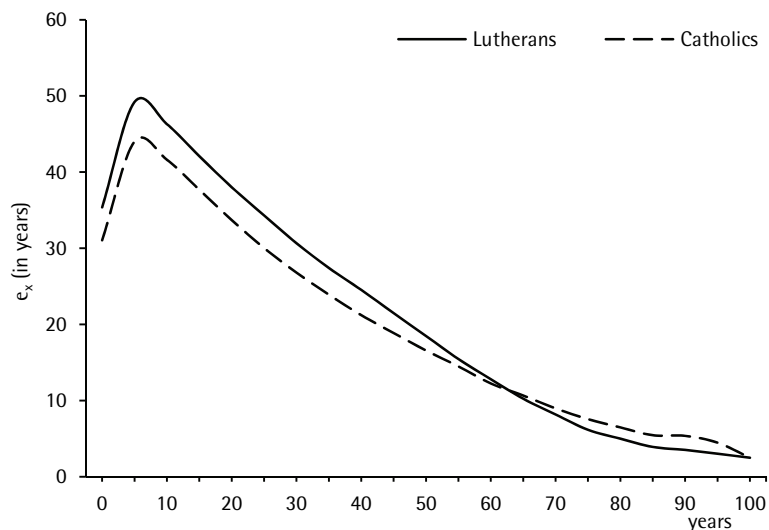


Table 4: Abridged Life Tables for Selected Age Categories in Catholic and Lutheran Populations from Greater Poland in the 19th Century (Stable Population Model*)

Age Category	Catholics				Lutherans			
	d_x	l_x	q_x	e_x	d_x	l_x	q_x	e_x
0	38.59	100.00	0.39	31.06	36.40	100.00	0.36	35.38
5	3.64	61.41	0.06	44.01	2.74	63.60	0.04	49.20
10	1.53	57.78	0.03	41.62	1.08	60.86	0.02	46.30
20	2.22	54.65	0.04	33.71	2.04	58.40	0.03	38.02
45	5.09	35.84	0.14	18.87	4.10	43.09	0.10	21.48
50	5.27	30.76	0.17	14.49	4.29	38.99	0.15	18.48
60	5.38	20.72	0.26	12.25	5.62	29.36	0.19	12.81

* Population growth (r) = 13.25 per 1,000 people, calculated for Greater Poland for the years 1846-1890, as the difference between CBR and CDR; after: Borowski 1970.

Life expectancy of a newly born child, estimated as the inverse of crude death rates, assumed slightly higher values in Lutherans (between 25-37 years) than in Catholics (21-36 years) (Figure 4).

Differences in the values of biometric functions of life tables between Catholics and Lutherans from Greater Poland in the second half of the 19th century reflected differences in total mortality and infant mortality, described by crude death rates (sub-section 5.2) and infant mortality rates (sub-section 5.3). Higher infant and child mortality rate in Catholic communities in comparison with

Lutheran ones was additionally confirmed by higher values of the Crow's index in the former than in the latter (Table 5).

Figure 4: Changes in the Life Expectancy of a Newly Born Child over time in Catholic and Lutheran Populations from the Poznań Province, 1845-1873

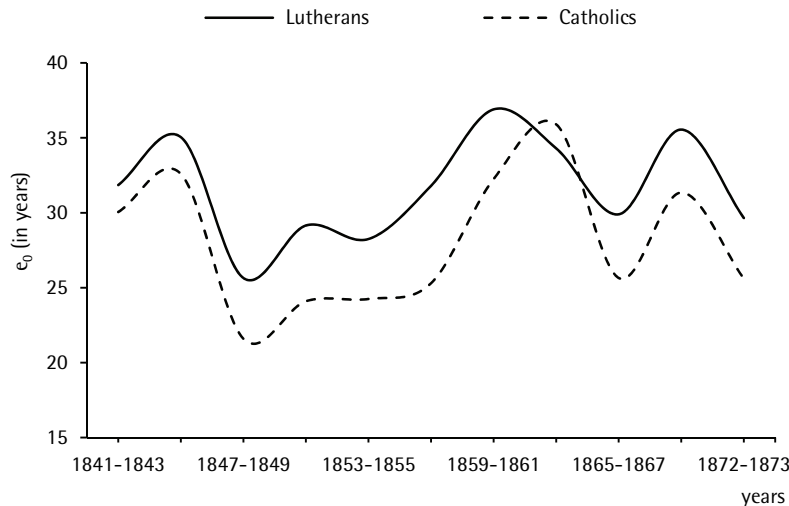


Table 5: Values of the Crow's Index in Catholic and Lutheran Populations from Greater Poland in the 19th Century

Religious denomination	stationary population model	stable population model*
Catholics	1.44	0.78
Lutherans	1.33	0.67

* Population growth (r) = 13.25 per 1,000 people, calculated for Greater Poland for the years 1846-1890; after: Borowski 1970.

5.4 Factors Influencing Mortality in Greater Poland

The above discussed picture of mortality of Catholics and Lutherans inhabiting the 19th-century Greater Poland was shaped by factors of ecological and cultural nature. The former were associated with the level of hygiene and sanitary-epidemiological level related to the size of the place of residence, while the latter were linked with socio-economic situation.

Let us repeat here again that the factor analysis made it possible to check whether it would be feasible to select some general, hidden factors influencing mortality in Greater Poland. On the basis of the Kaiser criterion, factors with the value of over 1 were selected for further parts of this analysis (Stanisz

2007) (Table 6). The 1st factor accounted for almost 23% of the total variance of mortality in Greater Poland, the 2nd factor – 13.7% of it, the 3rd factor – 12.4%, and the last one (4th factor) – 11.3% of the total variance.

Table 6: Eigenvalues of Factors

Value	Eigenvalues	% total Variance	Cumul. Eigenvalue	Cumul. %
1	2.0661	22.9565	2.0661	22.9565
2	1.2355	13.7283	3.3016	36.6848
3	1.1187	12.4302	4.4203	49.1150
4	1.0151	11.2791	5.4355	60.3941

Two variables: “Degree of urbanization” and “Level of hygiene” had high factor loadings (0.9831 and 0.9833, respectively) with the 1st factor (Table 7). In the 19th century the level of ecological and hygienic conditions was strongly related to the size of the place of residence, being poorer in cities and better in rural areas. Cities, contrary to villages, frequently suffered from infrastructural deficiencies, such as lack of access to clean water and of a sewage system, and had dramatically poor living conditions with working class population concentrated in extremely overcrowded districts. This phenomenon is well-known and well-documented in the literature (e.g. Budnik and Liczbińska 2006; Burnett 1991; Haines 1991; Knodel 1988; Landers 1993; Liczbińska 2009a, b, 2011, 2015; Preston and van de Walle 1978; Spree 1988, Vögele 1994, 1998).

Table 7: Factor Loadings from Factor Analysis (before Varimax Rotation)

Variables	1st Factor	2nd Factor	3rd Factor	4th Factor
Denomination	0.076142	0.172633	0.695287	-0.025952
Period	0.279767	-0.166988	-0.315090	0.104089
Sex	0.000045	-0.037377	0.091838	0.001540
Season of deaths	-0.041720	-0.056459	-0.185180	-0.936208
Degree of urbanization	0.983163	0.061941	-0.061929	-0.014827
Level of hygiene	0.983356	0.061939	-0.062277	-0.013950
Age at death	-0.082432	0.750476	-0.174516	0.218292
Causes of death	0.073680	-0.762431	0.179524	0.216168
Occupation	0.186903	0.146878	0.652717	-0.191760
Expl. variance	2.066562	1.236033	1.121870	1.019562
Prp. total	0.229618	0.137337	0.124652	0.113285

Variables: “Age at death” and “Causes of death” had the highest factor loadings with the 2nd factor (Table 7). The distribution of death causes by age is not identical in human ontogeny. In other words, in the 19th century same causes of death were typical of certain age groups. For example, deaths due to diarrhea and infectious diseases were observed mostly among infants and children (e.g. Liczbińska 2009a, 2011), tuberculosis was linked mainly to working groups (Landers 1993; Puranen 1991) whereas degenerative diseases – to elderly people (Liczbińska 2015).

The variable “Season of death” was related to the next factor (Table 7). The literature has emphasized the existence of a relationship between annual fluctuations of deaths and climatic factors. In cities an increase of mortality was noted in hot summer months and was caused by infectious diseases and intestinal diarrheas (e.g. Kemkes-Grottenthaler 2003; Knodel and Hermalin 1984; McQuillan 1999; Palloni and Tienda 1986; Schellekens and van Poppel 2006; van Poppel 1992). In rural areas a mortality peak was observed in the autumn and winter, caused by diseases of respiratory and circulatory systems (e.g. Budnik and Liczbińska 2015; Liczbińska 2009a, 2015; Zielińska 2012).

Table 8: Factor Loadings from Factor Analysis (after Varimax Rotation)

Variables	1st Factor	2nd Factor	3rd Factor	4th Factor
Denomination	0.020797	-0.003604	-0.712363	0.108586
Period	0.295648	0.115060	0.336931	0.045843
Sex	-0.011098	0.057122	-0.078750	0.015682
Season of deaths	-0.012593	-0.000232	0.018585	-0.956661
Degree of urbanization	0.986643	0.008220	-0.030446	0.006453
Level of hygiene	0.986854	0.008169	-0.029966	0.007258
Age at death	-0.021062	-0.772446	0.042333	0.221827
Causes of death	0.004264	0.788852	0.036925	0.204984
Occupation	0.135857	0.019342	-0.704904	-0.059983
Expl. variance	2.054387	1.235984	1.129400	1.024257
Prp. total	0.228265	0.137332	0.125489	0.113806

After Varimax rotation the participation of another factor was extended. It was associated with variables “Denomination” and “Occupation” (Table 8). As it has been mentioned earlier in this paper, in Greater Poland religious differences were along with economic and professional status. Wealthier Lutherans, mostly Germans, were represented by rich middle class, bourgeoisie, entrepreneurs and influential intelligentsia. Poorer Catholics, represented here mainly by Polish community, encompassed poorer classes, workers and lower middle class. Representatives of wealthy middle class and intelligentsia were scarce in this population (see: Section 1)

The 1st factor was called “Ecological Factor”, the 2nd one – “Biological Factor”, the 3rd one “Cultural Factor”, and the last factor – “Climatic one”. Ecological, biological, cultural and climatic factors explained 23%, almost 14%, 12%, and 11% of the total variance in mortality, respectively. In total, these 4 factors were responsible for 60% of the total variance of mortality in Greater Poland in the second half of the 19th century. Whereas religious denomination was merely one of cultural aspects (Table 8) connected with other factors of social and economic nature.

6. Conclusions

- 1) With regard to the historical Greater Poland, especially its urban areas, a religious factor affected a number of socio-economic variables, related to occupational status and therefore to the financial situation of a population. Catholics were represented mainly by unskilled and labour workers and lived in poorer social and environmental conditions. Lutherans, in turn, were distinguished by better education, better social positions, more lucrative professions, higher economic situation related to it, and thus a higher standard of living.
- 2) The Greater Poland Lutherans, represented mainly by migrants from various regions of Germany, differed in terms of tradition, religious practices, customs, habits, lifestyle, wealth, etc. Some differences were captured in their level of education: there were not only well-educated Lutherans, but some of them were illiterate, especially those from rural areas (Liczbińska 2015). This cultural diversity of Lutherans in Greater Poland could have led to difficulties in their internal integration, while the proximity of Catholics would favour their acculturation (Kiec 2001; Liczbińska 2012, 2015).
- 3) In light of the above, one can conclude that differences in mortality rates between Catholics and Lutherans from Greater Poland in the 19th century were not as clear as those between Catholic and Lutheran communities from the historical Western Europe which were distinctive by their old tradition and economic advancement.

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